the fastening bolt into the bolt hole in the second casing half is first transferred from the fastening bolt to the sleeve through the abutment of the fastening means and the end face of the sleeve, then transferred from the sleeve to the first casing segment through the engagement of the external screw thread of the sleeve and internal screw thread of the bolt hole in the first casing half and generates a fastening force for pressing the first casing half against the second casing half.

3. (Amended) A fastening arrangement as set forth in claim 2, wherein an enlarged diameter portion integrally formed on a shaft portion of the fastening bolt acts as the fastening means for abutting the end face of the sleeve.

4. (Amended) A fastening arrangement as set forth in claim 2, wherein an external screw thread is provided on a shaft portion of the fastening bolt and a nut engaging said external screw thread acts as the fastening element for abutting the end face of the sleeve.

## REMARKS

Favorable reconsideration of this application as presently amended and in light of the following discussion is respectfully requested.

Claims 1-4 are presently active in this case. Claims 1-4 have been amended by the present amendment.

Regarding the objection to the drawings, a Letter Requesting Approval of Drawing Changes is submitted herewith, and as indicated in the Office Action, Figure 3a, 7, 8 and 9 have been amended to include a legend --PRIOR ART--. Further, as indicated in the Office Action, the drawings must show every feature of the invention specified in the claims. Accordingly, in the drawings, an external screw thread 5e on a shaft of the bolt 5 with a nut

engaging the external screw thread for abutting the end face of the sleeve, as recited in Claim 4, is illustrated.

Regarding the objection to the specification, the specification has been amended in light of the comments noted in the outstanding Office Action and as shown in the marked-up copy. Accordingly, it is respectfully requested this objection be withdrawn.

Regarding the objection to Claims 1-4 because of informalities, the pending claims have been amended in light of the comments noted in the outstanding Office Action and as shown in the marked-up copy. In particular, in Claim 1, line 4, "segments" is amended to --segment-- and at line 26, "segments" has been deleted. Also, in Claim 2, line 5, "halves" has been amended to --half--. Accordingly, it is respectfully requested this objection be withdrawn.

Regarding the objection to Claims 3-4 under 35 U.S.C. § 112, second paragraph, the pending claims have been amended in light of the comments noted in the outstanding Office Action and as shown in the marked-up copy. In particular, in Claims 3 and 4, line 4, "the fastening element" has been amended to be --the fastening means--. Also, in Claim 4, line 3, "said external screw" has been amended to be --said external screw thread.-- Accordingly, it is respectfully requested this rejection be withdrawn.

As it is described in the specification, it is desirable to use a casing without flanges because the use of a casing in various environments may cause the temperature of the casing walls to vary in different portions, and thus a large thermal stress is generated by a difference in the amount of thermal expansion of the different portions of the casing. Therefore, the large thermal stress causes the casing to deform. In particular, if the casing is provided with flanges having a thickness different than other portions of the casing, distortion of the casing

may occur when the temperature throughout the different casing portions varies (specification, page 2, line 26 - page 3, line 11).

In order to solve the problem associated with temperature changes, a flangeless horizontal split type casing may be used. As illustrated in Figure 8, the casing halves are flangeless and the bolt holes for fastening bolts are drilled in the tangential direction in the walls of the casing halves. Spot facings are formed on the upper ends of the bolt holes in order to obtain a close contact between the surface of the casing half 210a around the bolt holes 210c and the bolt heads 215d of the fastening bolts 215 (specification page 3, line 35 - page 4, line 6). In the flangeless casing as shown in Figure 8, because flanges of varied thickness compared to the casing are not used, the distortion of the casing is minimized.

However, in the flangeless casings as shown in Figure 8, spot facings 210d are provided and the diameters of the bolt holes 210c above the spot facings are required to be the same as the diameters of the spot facings 210d (specification, page 4, lines 17-20). Therefore, the diameter of the bolt holes 210c becomes much larger than the minimum diameter required for allowing the bolt 215 to pass through (specification, page 4, lines 21-23). Therefore, a large amount of metal must be removed from the walls of the casing half 210a and reduced wall thickness portions are formed by the bolt holes 210c. As illustrated in Figure 8, the wall thickness becomes the smallest $t_1$ at a portion where the spot facings are formed.

According to the invention, in order to prevent the formation of the reduced wall thickness portions, it is desirable to reduce the diameters of the spot facings 210d. However, the diameter of the spot facings must be sized to the large tensile force which must be transferred from the fastening bolts to the casing 210 through the contacts between the bolt heads 215d and the spot facings 210d. Therefore, the maximum value of the contact pressure

between the bolt heads and the casing is based on the material strength of the casing. In particular, the diameter of the spot facing must be sufficiently large in order to reduce the contact pressure between the bolt head and the casing to within an allowable limit, based on the material of the casing, while maintaining a sufficiently large tensile force of the fastening bolt. Therefore, it would be difficult to reduce the diameter of the spot facings in order to increase the wall thickness of the casing around the spot facings.

According to the invention, by inserting a cylindrical sleeve made of a high strength material similar to that of the fastening bolt 5 such that the diameter portion 5c of the fastening bolt abuts the upper end face of the sleeves, the allowable contact pressure between the enlarged diameter portion 5c and the upper end face 11a of the sleeve is much greater than that in the case where the bolt head of the fastening bolt 5 directly contacts the upper casing 2. Consequently, the contact pressure may be set at a higher value such that the contact between the enlarged diameter portion 5c and the upper end face 11a of the sleeve is minimized. Therefore, the outer diameters of the enlarged portion 5c of the bolt 5 and the sleeve may be set at a value smaller than the diameter of the spot facing required in the configuration where the bolt head directly contacts the upper casing.

In the outstanding Office Action, Claim 1 was rejected under 35 U.S.C. § 102(b) as being anticipated by Swiss Patent 171,458 (Figure 1).

Briefly, Claim 1 defines a fastening arrangement for a split hollow casing including a first and a second casing segments assembled together by joining joint faces of the respective casing segments and when the first and second casing segments are assembled together, form a continuous bolt hole crossing the joint bases and extending in walls of both casing segments. Further, the walls of the casing segments separate an interior of the hollow casing from an exterior of the hollow casing.

For example, as shown in Figure 1, the fastening bolt 5 passes through bolt hole 7 drilled in the upper casing 1 and perpendicular to the joint face 3, and the screw threads 5a at the end thereof are screwed into the thread holes 5b formed on the joint faces 3 of the lower casing 2. Thus, when the first and second casing segments are assembled together, a continuous bolt hole crossing the joint bases and extending in walls of both casing segments is formed. The walls of the casing segments separate an interior of the hollow casing from an exterior of the hollow casing.

Swiss Patent 171,458 Figure 1 discloses a linear pipe with a top portion 1 and a bottom portion 2 connected together by flange portions 3 and 4, respectively. A bolt connecting mechanism is disposed through flange portions 3 and 4 which are formed on an *exterior* surface of the pipe. Thus, the bolt connecting mechanism crosses merely a portion of the pipe rather than a portion of the pipe separating the exterior from the interior.

According to the invention, it also has been unexpectedly found that a fastening arrangement including a sleeve having external screw thread and being fitted into the bolt hole of the first casing segment permits a reduction in the side of the bolt hole. Particularly, for a continuous bolt hole crossing the joint faces and extending in the walls of both casing segments where the walls of the casing segment separate an interior of the hollow casing from an exterior of the hollow casing, the bolt holes can be minimized and the integrity of the casing is therefore improved. In fact, Swiss Patent 171,458 discloses a nut with a greater diameter than that of the bolt hole of flanges 3 and 4 and does not show a need to make the hole smaller or appreciate the advantage of the present invention. In fact, using a larger sized fastening member 6, as shown in Figure 1 of Swiss Patent 171,458, in a bolt hole formed in the walls of both casing segments of the present invention, would require enlarging the bolt hole of a flangeless casing, and therefore Swiss Patent 171,458 teaches away from the present

invention. Thus, there is no motivation to combine the fastening assembly of Swiss Patent 171,458 in a casing that is flangeless and includes the larger sized fastening member to arrive at the present invention. Thus, there is no disclosure in Swiss Patent 171,458 of a continuous bolt hole crossing the joint faces and extending in the walls of both casing segments where the walls of the casing segments separating an interior of the hollow casing from an exterior of the hollow casing is provided, as defined in Claim 1.

Therefore, it is respectfully submitted Claim 1 and claims depending therefrom patentably define over the applied art.

In the outstanding Office Action, Claims 2-4 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Walsh in view of Swiss Patent 171,458.

Claim 2 defines a fastening arrangement for a horizontally split type hollow including first and second casing halves which when assembled together form a continuous bolt hole crossing the joint faces and extending in walls of both casing halves, and further the walls of the casing halves separate an interior of the split type hollow casing from an exterior of the split type casing, similar to the features also recited in amended Claim 1 which is discussed to be allowable. Thus, for reasons similar to those discussed in Claim 1, Claim 2 is also believed to be allowable. Further, it is respectfully submitted Walsh also does not teach or suggest the features recited in Claim 1. Therefore, it is respectfully requested this rejection also be withdrawn.

In the outstanding Office Action, Claims 2-4 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Applicant's prior art Figure 7 in view of Swiss Patent 171,458.

Applicant's prior art Figure 7 discloses a bolt and fastening member which secure flange portions 110b and 120b of a first casing portion 110a and a second casing portion 120a, respectively. However, Applicant's prior art Figure 7 does not disclose a continuous

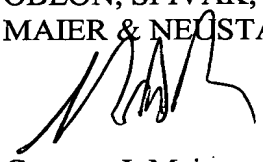
bolt hole crossing the joint facings and extending in walls of both casing halves separating an interior of the hollow casing from an exterior of the split type hollow casing, as claimed in Claim 2.

Further, the Office Action indicates Swiss Patent 171,458 is from the analogous art of high temperature pipe joints, and one of ordinary skill in the art would have looked at the art of high temperature pipe joints in order to solve the problem of differential thermal expansion in high temperature hydraulic casings. Further, the Office Action indicates it would have been obvious at the time the invention was made to a person having ordinary skill in the art to fit the casings of Applicant's prior art Figure 7 with the fastening and sleeve arrangement of the Swiss Patent 171,458, for the purpose of reducing leaking by preventing the expansion differences between the bolt, nuts, and casing from permanently changing the form of the bolts, nuts, or casings. However, by using the casing of Applicant's *flanged* prior art Figure 7 with the fastening sleeve arrangement of the Swiss Patent, one would not arrive at the Applicant's invention of Claim 1. Therefore, it is respectfully submitted that Claim 2 and claims depending therefrom patentably define over the applied art.

Consequently, in view of the present amendment and in light of the above discussion, the outstanding grounds for rejection are believed to have been overcome. The application as amended herewith is believed to be in condition for formal allowance. An early and favorable action to this effect is respectfully requested.

Respectfully requested,

OBLON, SPIVAK, McCLELLAND,
MAIER & NEUSTADT, P.C.



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**Marked-Up Copy**
Serial No:
09/680,400
Amendment Filed on:
July 2, 2002

IN THE SPECIFICATION

Please amend the specification as shown below:

Page 2, beginning at line 23, please amend the paragraph to read as follows:

--In hydraulic machines having rotors, the casings containing rotors must have strictly circular cross sections especially at the inner peripheries. However, in the turbines and compressors, since the temperature of the fluid passing through the casings is high, the temperature of the respective portions of the casings becomes high. If the temperature of the casing wall varies in the respective portions, a large thermal stress is generated by the difference in the amount of the thermal expansion of the respective portions of the casing. when a large thermal stress is generated, the casing tends to deform and concentricity of the cross section of the casing cannot be maintained. Further, in the turbines and compressors, the temperature of the fluid passing through the machines changes considerably due to a change in the operating load. In this case, if the casing is provided with flanges having a thickness larger than other portions of the casing, the change in the temperature of the flanges is late compared with the other portions. This causes a large temperature difference between the flanges and other casing portions when the rate of the change in the temperature of the fluid in the casing is high. Therefore, if the casing is provided with [flange] flanges having a

large thickness, distortion of the casing may occur when the temperature of the fluid changes.--

Page 3, beginning at line 12, please amend the paragraph to read as follows:

--In turbines and compressors, rotors rotating at high speed are accommodated in the casings. Therefore, if distortion of the casing occurs, the outer periphery of the rotor (such as the tips of the turbine blades) [contact] <u>contacts</u> with the inner periphery of the casing. This may cause damage to the machine. It is true that the contact between the rotor and the casing can be avoided even in this case if the clearance between the tips of the turbine blades and the inner periphery of the casing is set at a relatively large value. However, in the hydraulic machines such as turbines and compressors, since the efficiency of the machine decreases as the tip clearance becomes larger, it is not practical to set the tip clearance to a large value.--

Page 4, beginning at line 29, please amend the paragraph to read as follows:

--Fig. 9 schematically shows a section of the wall of the casing half 210a around the spot facings 210d taken along the line A-A in Fig. 8. As can be seen from Fig. 9, the wall is cut off in a cylindrical shape around the spot facings 210d and only a solid metal in the shape of the hatched area [is remained] <u>remains</u>. The average wall thickness of the portions shown by the hatched area is represented by $T_2$ in Fig. 9. In other words, the effective wall thickness of the casing around the spot facings is reduced to a substantially small value $T_2$ when the spot facings are formed. Therefore, in the flangeless casing in Fig. 8, reduced wall thickness portions are formed in the casing 210a by the spot facings 210d. Since the distortion of the casing occurs at these reduced wall thickness portions when the internal pressure or temperature of the casing is high, problems similar to those of the flanged casing of Fig. 7 occur.--

Page 9, beginning at line 24, please amend the paragraph to read as follows:

--Figs. 3A schematically illustrates the thickness of the casing at spot facings according to the [related] prior art in Fig. 8;--

Page 11, beginning at line 9, please amend the paragraph to read as follows:

--Fig. 2 is an enlarged view of the portion indicated by II in Fig. 1. As can be seen from Fig. 2, an internal screw thread 9a is formed on the inner surface of the bolt hole 7 near the joint face 3. A cylindrical sleeve 11 having external thread 9b which engages the internal thread 9a is fitted in the bolt hole 7 by screwing the sleeve 11 into the bolt hole 7. When the sleeve [9] 11 is fitted into the bolt hole 7, a clearance is formed between the lower end 11b of the sleeve 11 and the joint face 3 in order to avoid the contact between the lower end 11b of the sleeve 11 and the joint face 3 of the lower casing 2 when the fastening bolt 5 is fully tightened.--

Page 11, beginning at line 22, please amend the paragraph to read as follows:

--An enlarged diameter portion 5c is formed on the shaft portion of the fastening bolt 5 at the portion located inside of the bolt hole 7 when the bolt 5 is tightened. An external screw thread 5e may be formed on the shaft of the bolt. The diameter of the enlarged diameter portion 5c is slightly smaller than the diameter of the bolt hole 7. When the fastening bolt 5 is screwed into the threaded hole 5b of the lower casing 2, the lower face of the enlarged diameter portion 5c is pressed against the upper end face 11a of the sleeve 11. Therefore, when the fastening bolt 5 is further tightened, a tensile force is generated in the shaft portion of the fastening bolt 5. The reaction force of this shaft tensile force is transferred from the enlarged diameter portion 5c to the upper end face 11a of the sleeve 11 and a downward force is exerted on the sleeve 11. Since the external thread 9b of the sleeve 11 engages the internal thread 9a of the bolt hole 7, the downward force exerted on the sleeve

11 is received by the upper casing 1. Thus, the shaft tensile force of the fastening bolt 5 is converted to a tightening force which presses the upper casing 1 against the lower casing 2.--

Page 12, beginning at line 13, please amend the paragraph to read as follows:

--In this embodiment, materials having a relatively low strength such as a carbon steel for boilers and pressure vessels (for example, Japanese industrial standard (JIS) SB410) or a cast steel for high temperature and high pressure (for example, JIS SCPH32) are used for the upper casing 1 and lower casing 2 to facilitate machining of the upper and lower casings. On the other hand, a material having a high strength, such as alloy steel bolting material (JIS SNB7) or heat resisting steel (JIS SUH616) is used for the fastening bolts 5 in order to obtain a large tightening force of the casing 10. Therefore, if the conventional fastening arrangement in which the bolt heads of the fastening bolts directly contact the upper casing is used, the maximum allowable contact pressure between the bolt heads and the casing is limited by the strength of the material used for casing. Thus, as explained before, spot facings having large diameters are required for the casing in order to lower the contact pressure between the bolt heads and the casing. This causes the problems explained before, i.e., a smaller wall thickness of the casing at the spot facings and a larger intervals of the fastening bolts.--

IN THE CLAIMS

Please amend the claims as shown below:

--1. (Amended) A fastening arrangement for a split casing assembled by fastening a plurality of casing segments, comprising:

a first and a second casing segments assembled together by joining joint faces of the respective casing segments, said first and second casing segments are provided with bolt

holes in such a manner that the bolt hole of the first casing segment and the bolt hole of the second casing segment align with each other and, when the first and the second casing segments are assembled together, form a continuous bolt hole crossing the joint faces and extending in walls of both casing segments, the walls of the casing segments separating an interior of the hollow casing from an exterior of the hollow casing, and[,] at least the bolt hole in the first casing segment is provided with an internal screw thread;

a sleeve having an external screw thread and being fitted into the bolt hole of the first casing segment by engaging the external screw thread of the sleeve with the internal screw thread of the bolt hole of the first casing segment; and

a fastening bolt provided with fastening means and passing through the bolt hole of the first casing segment and the sleeve therein, wherein said fastening means abuts an end of the sleeve opposite to the joint face and, when a tensile force is exerted on the fastening bolt at the portion between the fastening means and the second casing segments, the tensile force is first transferred from the fastening bolt to the sleeve through the abutment of the fastening means and the end face of the sleeve, then transferred from the sleeve to the first casing segment through the engagement of the external screw thread of the sleeve and internal screw thread of the bolt hole and generates a fastening force for pressing the first casing segment against the second casing segment.

2. (Amended) A fastening arrangement for a horizontally split type hollow casing for a hydraulic machine in which the casing of the hydraulic machine is assembled by fastening two casing halves, comprising:

[a] first and a second casing halves assembled together by joining joint faces of the respective casing halves, said first and second casing halves are provided with bolt holes in such a manner that the bolt hole of the first casing half and the bolt hole of the second casing

half align with each other and, when the first and the second casing halves are assembled together, form a continuous bolt hole crossing the joint faces and extending in walls of both casing halves, the walls of the casing halves separating an interior of the split type hollow casing from an exterior of the split type hollow casing, said bolt holes in the first and the second casing halves are provided with internal screw threads;

a sleeve having an external screw thread and being fitted into the bolt hole of the first casing half by engaging the external screw thread of the sleeve with the internal screw thread of the bolt hole of the first casing half; and

a fastening bolt provided with an external screw thread at one end for engaging the internal screw thread of the bolt hole in the second casing half and fastening means at the portion apart from said external screw thread, said fastening bolt passing through the bolt hole of the first casing half and the sleeve therein, wherein said fastening means abuts an end of the sleeve opposite to the joint face when the fastening bolt is screwed into the bolt hole in the second casing half, whereby a tensile force generated in the fastening bolt by screwing the fastening bolt into the bolt hole in the second casing half is first transferred from the fastening bolt to the sleeve through the abutment of the fastening means and the end face of the sleeve, then transferred from the sleeve to the first casing segment through the engagement of the external screw thread of the sleeve and internal screw thread of the bolt hole in the first casing half and generates a fastening force for pressing the first casing half against the second casing half.

3. (Amended) A fastening arrangement as set forth in claim 2, wherein an enlarged diameter portion integrally formed on a shaft portion of the fastening bolt acts as the fastening [element] means for abutting the end face of the sleeve.

4. (Amended) A fastening arrangement as set forth in claim 2, wherein an external

screw thread is provided on a shaft portion of the fastening bolt and a nut engaging said external screw thread acts as the fastening element for abutting the end face of the sleeve.--

Fig. 2

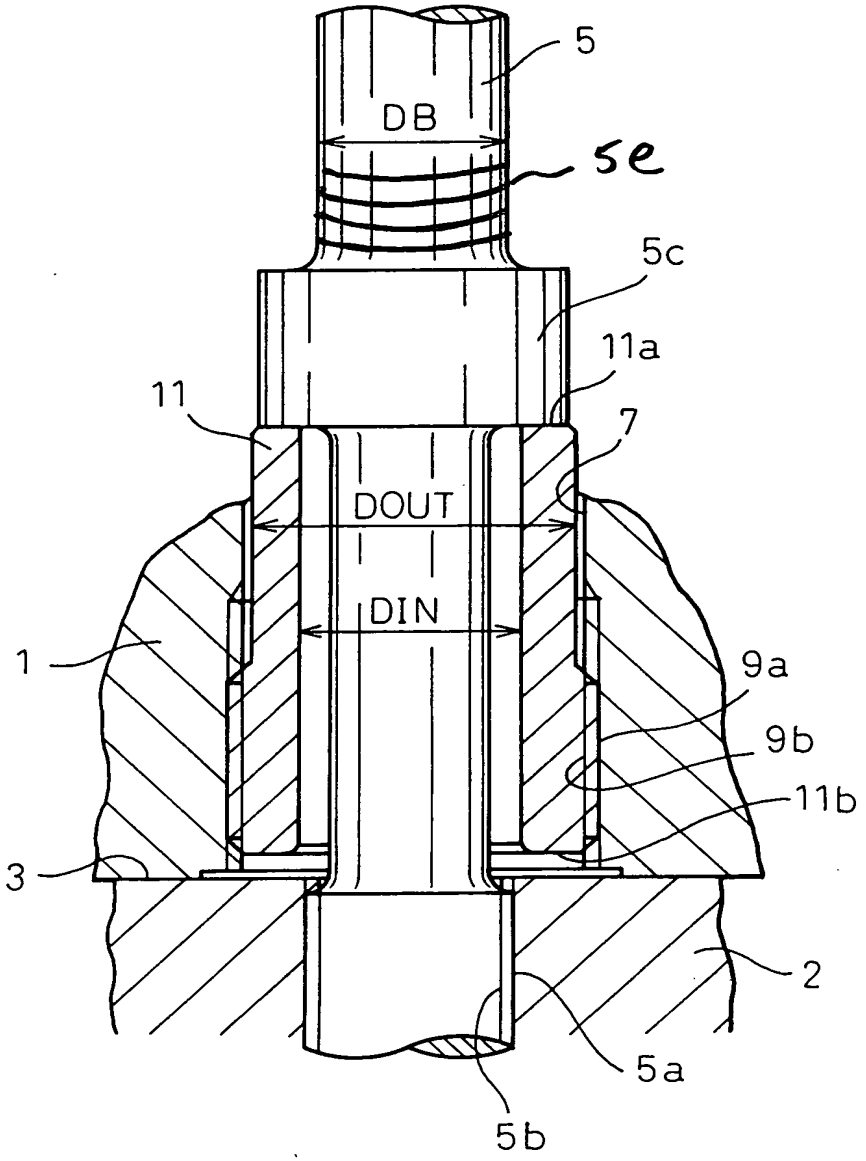
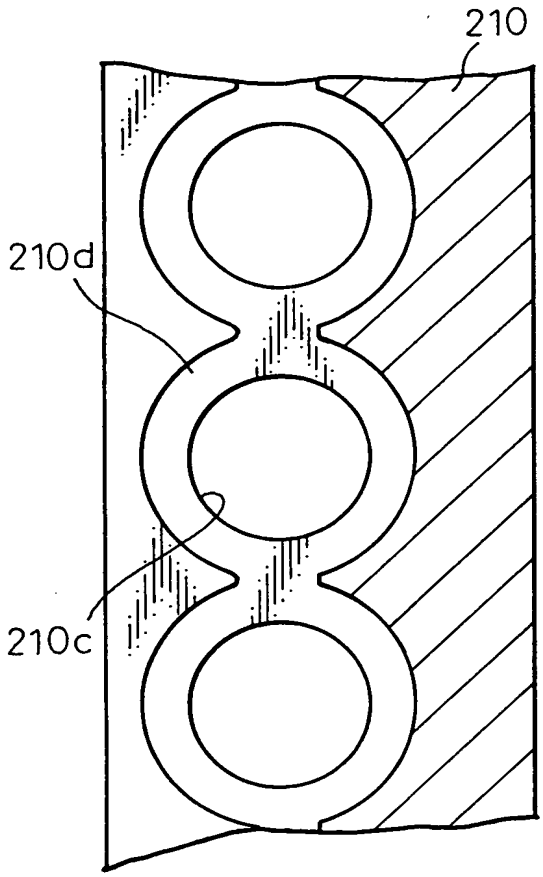


Fig.3A




RELATED ART

PRIOR ART

Fig.3B

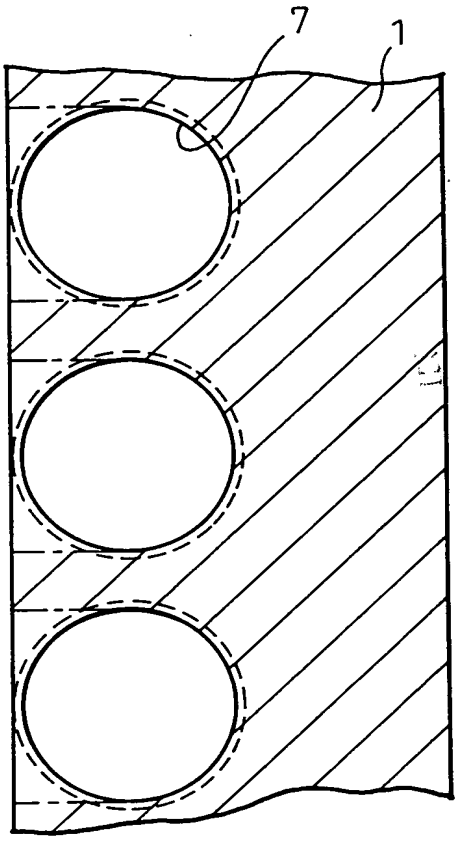
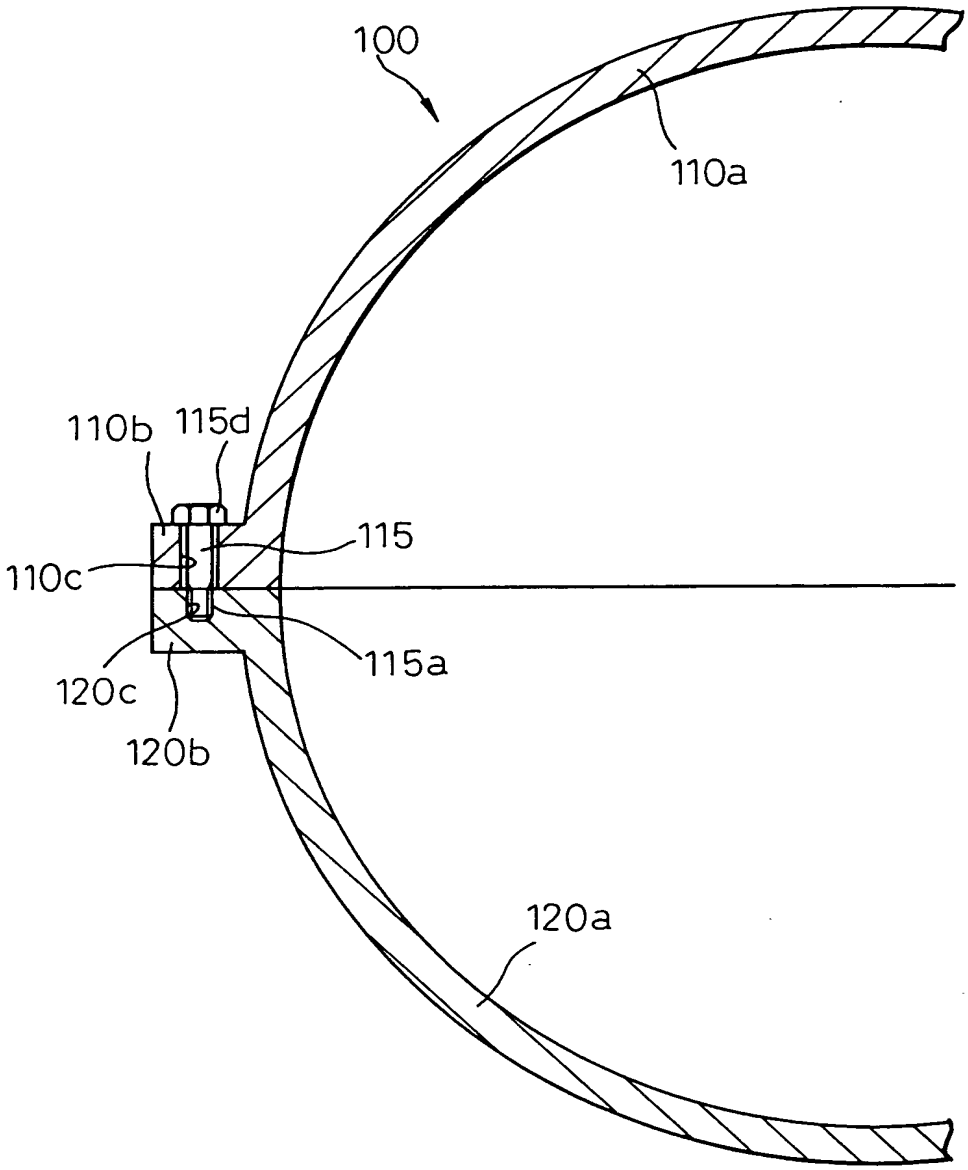


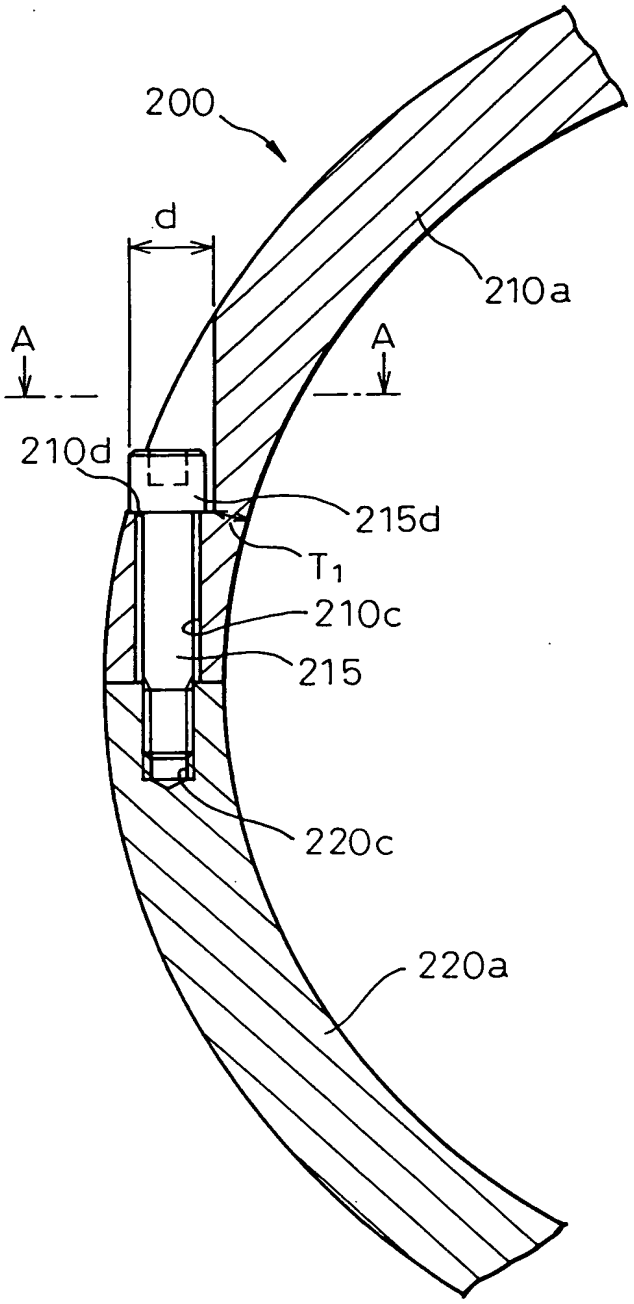
Fig.7




RELATED ART

PRIOR ART

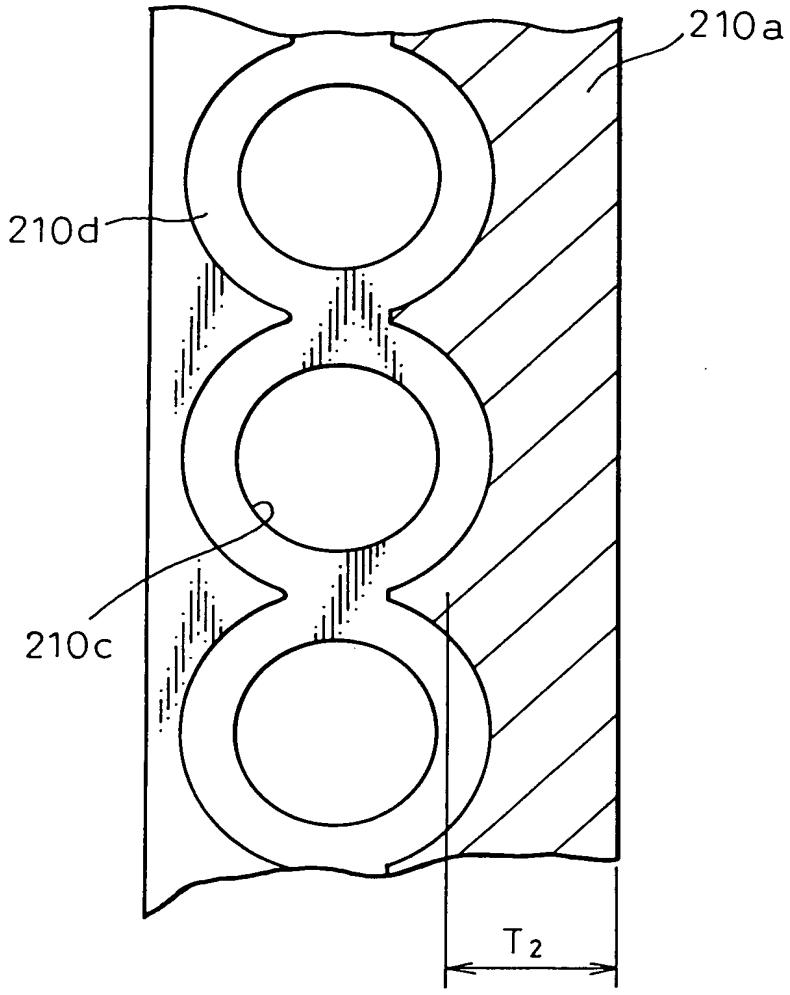
Fig. 8




RELATED ART

PRIOR ART

Fig. 9

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